

Erosion and Sedimentation Basics



Coastal San Luis Resource Conservation District



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Outline:

1. Terms & Concepts
2. Causes of Erosion
3. The Erosion/Sedimentation Process
4. Erosion Control vs. Sediment Control
5. Predicting Soil Loss
6. BMP Basics



What is Erosion?

- Erosion is the wearing away of the earth's surface by the action of external forces.
- Generally we are concerned about erosion caused by falling or flowing water.
- Not the same as sedimentation!

What Causes Erosion?

Energy!

- Erosion occurs when the energy of falling or flowing water exceeds the soil's ability to resist movement.
- Impact Erosion – Raindrops detach soil particles
- Scour – Flowing water removes soil.



Types of Erosion

- Impact Erosion – Raindrops detach soil particles
- Sheet Erosion – Removal of thin layers of soil by Sheets of un-concentrated flowing water.
- Rill Erosion – The formation of small “streamlets” due to uneven detachment and mild concentration of flow.
- Gully Erosion – Larger cuts formed by concentrated flowing water.
- Mass Waste – Bank or slope failure resulting in major, rapid erosion.

Rill Erosion



Gully Erosion



Other Terms

➤ Sedimentation– The settling or deposition of soil particles eroded upstream.

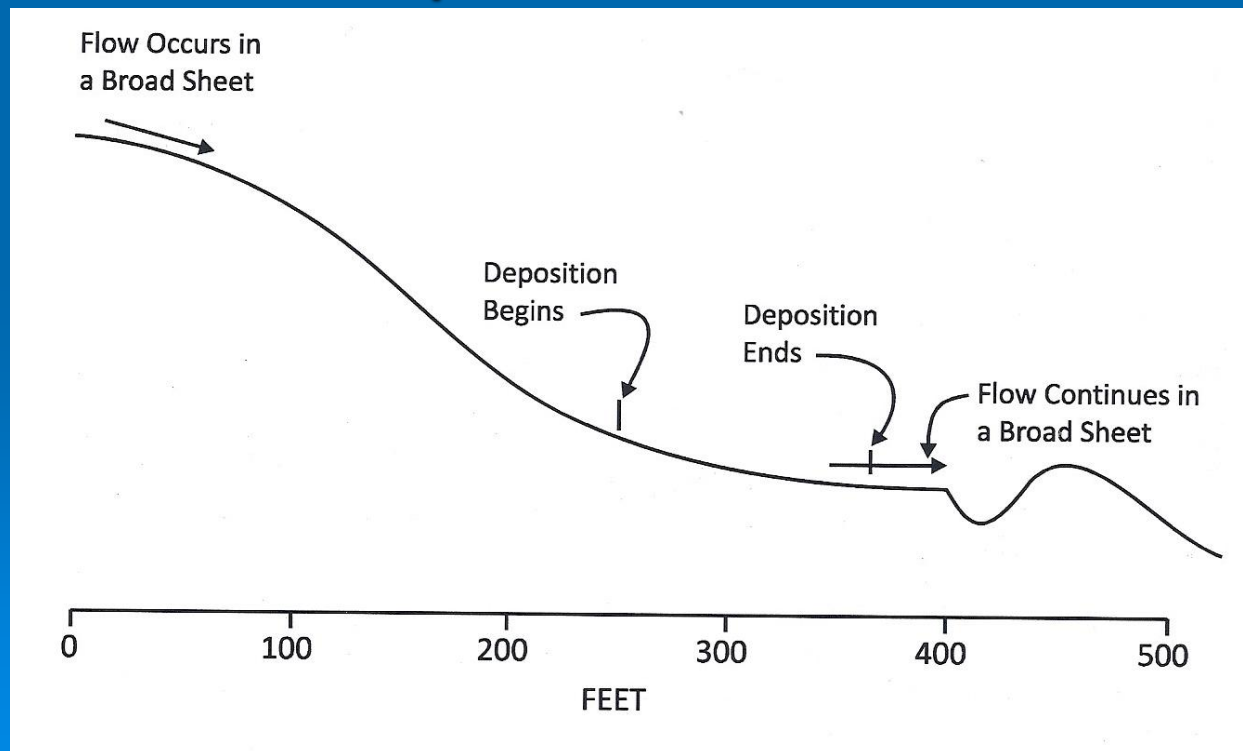
➤ Sediment Yield – The amount of Sediment delivered to a point.

$$\text{Yield} = \text{Total Erosion} - \text{Total Deposition}$$

➤ Best Management Practice (BMP) – Methods of controlling erosion and/or sedimentation.

The Process

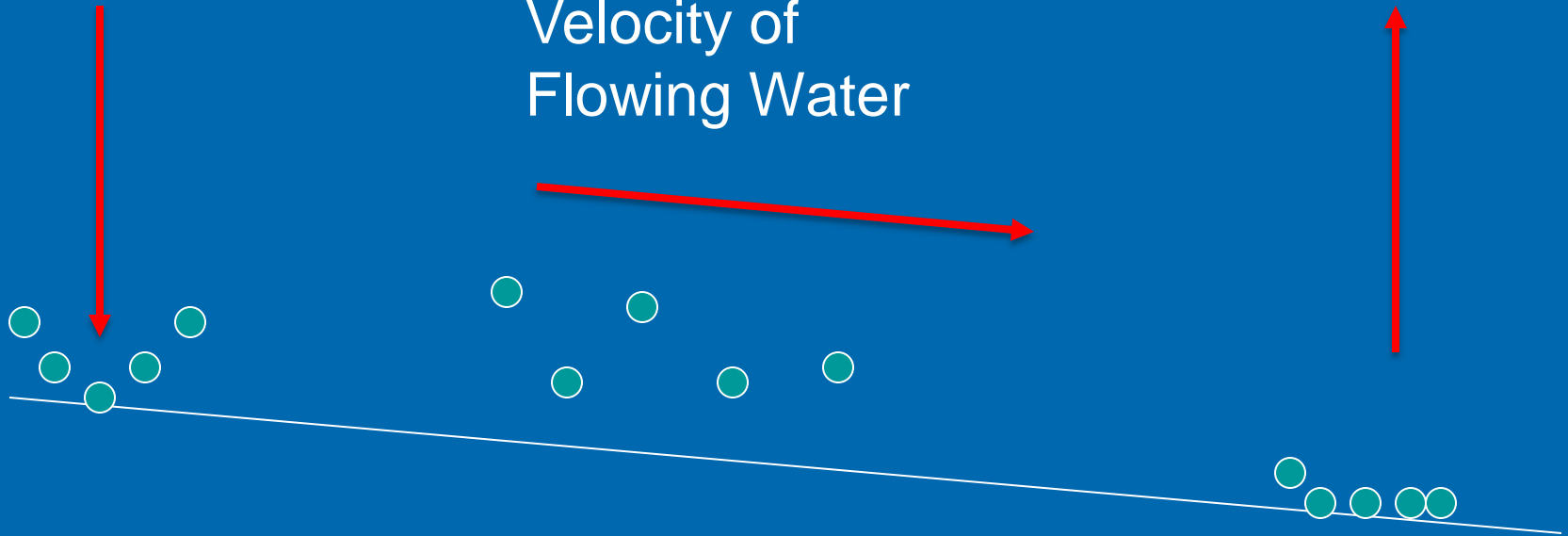
- 1. Detachment
- 2. Sediment Transport
- 3. Sediment Deposition



Impact
Energy

Loss of energy

Velocity of
Flowing Water



Detachment
(erosion)

Sediment
Transport and
Scour

Deposition
(sedimentation)

Erosion Control vs. Sediment Control

➤ Erosion Control –

- Keep soil in place
- Proactive
- More effective than sediment control
- Less expensive than sediment control

➤ Sediment Control -

- Catch soil after it moves
- Reactive
- **The Last Resort!**

Predicting Soil Loss

➤ The RUSLE Equation:

- Revised
- Universal
- Soil
- Loss
- Equation

➤ Estimated the long-term, average annual sheet and rill erosion in tons/acre/year.

➤ Does not estimate Sediment yield or erosion from a single storm.

➤ Equation: $A = R \times K \times L \times S \times C \times P$

- A = Annual Soil Loss (tons/acre/year)
- R = Rainfall-Runoff Factor – Based on rainfall
- K = Soil Erodibility Factor – Based on Soil Type
- L = Slope Length Factor – Length can increase erosion.
- S = Slope Steepness Factor – Steepness increases velocity of water.
- C = Cover-Management Factor – Grass, Mulch, Hay etc.
- P = Erosion Control Practice Factor – Smooth and compacted soil vs. loose rough soil.

Slope (%)	Horizontal Slope Length (ft.)															
	<3	6	9	12	15	25	50	75	100	150	200	250	300	400	600	1000
0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06
0.5	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.10	0.11	0.12	0.13
1.0	0.09	0.09	0.09	0.09	0.09	0.10	0.13	0.14	0.15	0.17	0.18	0.19	0.20	0.22	0.24	0.27
2.0	0.13	0.13	0.13	0.13	0.13	0.16	0.21	0.25	0.28	0.33	0.37	0.40	0.43	0.48	0.56	0.69
3.0	0.17	0.17	0.17	0.17	0.17	0.21	0.30	0.36	0.41	0.50	0.57	0.64	0.69	0.80	0.96	1.23
4.0	0.20	0.20	0.20	0.20	0.20	0.26	0.38	0.47	0.55	0.68	0.79	0.89	0.98	1.14	1.42	1.86
5.0	0.23	0.23	0.23	0.23	0.23	0.31	0.46	0.58	0.68	0.86	1.02	1.16	1.28	1.51	1.91	2.55
6.0	0.26	0.26	0.26	0.26	0.26	0.36	0.54	0.69	0.82	1.05	1.25	1.43	1.60	1.90	2.43	3.30
8.0	0.32	0.32	0.32	0.32	0.32	0.45	0.70	0.91	1.10	1.43	1.72	1.99	2.24	2.70	3.52	4.91
10.0	0.35	0.37	0.38	0.39	0.40	0.57	0.91	1.20	1.46	1.92	2.34	2.72	3.09	3.75	4.95	7.02
12.0	0.36	0.41	0.45	0.47	0.49	0.71	1.15	1.54	1.88	2.51	3.07	3.60	4.09	5.01	6.67	9.57
14.0	0.38	0.45	0.51	0.55	0.58	0.85	1.40	1.87	2.31	3.09	3.81	4.48	5.11	6.30	8.45	12.23
16.0	0.39	0.49	0.56	0.62	0.67	0.98	1.64	2.21	2.73	3.68	4.56	5.37	6.15	7.60	10.26	14.96
20.0	0.41	0.56	0.67	0.76	0.84	1.24	2.10	2.86	3.57	4.85	6.04	7.16	8.23	10.24	13.94	20.57
25.0	0.45	0.64	0.80	0.93	1.04	1.55	2.67	3.67	4.59	6.30	7.88	9.38	10.81	13.53	18.57	27.66
30.0	0.48	0.72	0.91	1.08	1.24	1.86	3.22	4.44	5.58	7.70	9.67	11.55	13.35	16.77	23.14	34.71
40.0	0.53	0.85	1.13	1.37	1.59	2.41	4.24	5.89	7.44	10.35	13.07	15.67	18.17	22.95	31.89	48.29
50.0	0.58	0.97	1.31	1.62	1.91	2.91	5.16	7.20	9.13	12.75	16.16	19.42	22.57	28.60	39.95	60.84
60.0	0.63	1.07	1.47	1.84	2.19	3.36	5.97	8.37	10.63	14.89	18.92	22.78	26.51	33.67	47.18	72.15

BMP Goals

- 1. Keep soil in place
 - Maintain adequate cover.
 - Vegetation is preferable.
- 2. Prevent concentrated flow
 - Out-slope roads, spread flow out at culverts.
 - Control water when it becomes concentrated.
- 3. Reduce Velocity
 - Flatten slopes and reduce slope length.
 - Roughen soils surface.

BMP Goals

- Keep soil in place
 - Minimize removal of existing vegetation whenever possible.
 - Reseed with natives.
 - Use artificial cover until vegetation is established.



BMP Goals

➤ Keep soil in place

- Seed and cover with straw until established
- 3000 lbs of straw/acre for best results.
- Irrigate if possible.



BMP Goals

- Keep soil in place
 - Seed and cover with fabric until established
 - Best for steep slopes.



BMP Goals

- Reduce Slope Length
 - Use Straw wattles to break-up long slopes
 - Must be keyed in and installed properly



- Avoid concentrating flows

BMP Goals

- Avoid concentrating flows
 - Out-slope roads



BMP Goals

- Use sediment control as a last resort.
 - Silt Fence or Basins are not as effective as erosion control



Summary

- Reduced Energy = Reduced Erosion
 - Cover reduces raindrop energy.
 - Shorter flatter slopes reduces velocity energy.
- Prevent concentrated flow whenever possible.
- Minimize the removal of existing vegetation whenever possible.
- Use sediment control as a last resort.



Questions?

